THE AUTHORS' REPLIES TO THE ABOVE DISCUSSION

Sir Edward Appleton (*in reply*): I strongly support Dr. Smith-Rose's plea for continued, and indeed extended, post-mortem examination of operational results. Only in this way is it possible to check the accuracy of our ionospheric predictions. Moreover, nature has many surprises for us in work of this kind, and, with a laboratory as large as the earth itself, it is only with the co-operation of an army of radio operators that we can ensure that many interesting abnormalities do not escape attention.

Dr. L. Harang's measurements of the values of the scale height H, by way of the distribution of auroral luminosity, are elegant in themselves and provide a much-needed confirmation of the values obtained by radio sounding alone.

Mr. Beghian's notable result, expressed by his formula for the resultant field strength, prompts the recollection that Kennelly, in his original paper on the hypothesis of a reflecting layer, suggested that the effect of such a layer would be to restrict the spread of radio energy to a two-dimensional divergence, the field strength varying inversely as the square root of the distance from the sending station.

Major Kojan's reminder that there are still certain unsolved problems in connection with the E-layer is most timely. Now that the war is over, attention can be paid to these matters. For that purpose we need really accurate measurements of E-layer critical frequency over a wide range of latitudes and preferably over a narrow range of longitude, in order that the varying influence of solar activity may not complicate the results.

Mr. Naismith and I made a study of radio conditions in high latitudes during the International Polar Year 1932–33 and I should like to refer Mr. Stanesby to our paper on the subject.* Briefly, we found that weak magnetic activity was associated with the occurrence of abnormal or sporadic E-layer ionization, but that, during severe magnetic storms, there was intense absorption, presumably due to augmented D-layer ionization. But this early work on polar conditions has more recently been greatly extended by studies in Alaska and Canada.

I think the answer to Mr. Bennington's question about the persistence of nocturnal E-layer ionization is as follows. During the night the normal E-layer ionization, produced in day-time, sinks to a low value. Abnormal or sporadic E-layer effects, which continue both by day and by night, therefore become the major influences and maintain the ionization at a value which exceeds the residual amount estimated from day-time conditions.

* *Philosophical Transactions of the Royal Society*, A, 1937, **236**, p. 191.

Mr. Naismith's remarks on the inadequacy of the present triple-zone presentation of ionospheric data, based on his own extensive experience in these matters, are likely to command general agreement.

Messrs. K. W. Tremellen and **J. W. Cox** (*in reply*): Mr. Millington is right in pointing out that we have tried to enable the engineer to use routine processes in the many cases where nothing better is available.

In reply to Mr. Naismith, the three-zone method was originated as an improvement when we definitely did not have enough data to use more than three charts. There is no doubt that it will be better to use more charts when the data for them are available. We have used them for research purposes, but the amount of labour involved did not seem to be justifiable at the time for routine work. We think Mr. Naismith may be rather dogmatic in the figures he quotes for the percentage errors.

Messrs. Humby and Stanesby refer to auroral-zone conditions. We did not have space to deal with these, but, as Mr. Humby shows, the exact placing of stations near the auroral zone can be of great importance. Unfortunately we cannot promise Mr. Stanesby the good conditions inside the zone which he hopes for, as it is known that at times there is plenty of high attenuation there. In evaluating circuits with one terminal inside the zone, account must be taken of the direction of crossing the zone (Section 7.4). Work on this subject is actively in progress. With regard to Mr. Stanesby's remark concerning the frequent absence of data on the charts for Antarctic and Arctic regions, we have very little ionosphere data for the Antarctic regions, and, although we have considerable data for the Arctic regions, the interpretation of the records obtained is very often difficult or impossible, especially during the Arctic winter.

Dr. Smith-Rose and others emphasize the need for more information about radio noise and the importance of checking predictions by "post mortem" examinations, and we fully agree with them.

Mr. Bennington suggests using the expression ionosphere storm. This is, of course, correct, although any part of the ionosphere may occasionally be disturbed without other parts being affected, and it is not easy to give a precise meaning to the term ionosphere storm. When we speak of magnetic storms, we really mean magnetic-storm conditions, or ionosphere disturbances connected with magnetic storms. With regard to the variation of atmospheric noise over the sunspot cycle, we agree that there probably is a variation, but we have as yet insufficient knowledge to allow for this change.